

Original Article

Relationship between exclusions and final results in European Championships, World Championships and Olympic Games in men's handball 1982-2014

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Abstract:

Situations of numerical inferiority in handball have influence on the development of the game since they produce an imbalance between players on both teams. The objective of this study is to establish the relationship between the exclusions against a team and the final result of the match during the 32 finals of European Championships, World Championships and Olympic Games between 1982 and 2014. The analysis is structured in four Grand Olympiads (GO) for eight years: 1982-1988, 1989-1996, 1997-2004 and 2005-2014. It was carried out the notational analysis of videotape recordings with SportCode Pro v.8.5.2. software, leading to 185 situations of inferiority. The Kruskal-Wallis statistic test did not establish significant differences ($p>0.05$) between the number of exclusions per match and the victory of such match. On the other hand, the study establishes an increase of the number of exclusions from the half of the second time of the match during the last Grand Olympiad. This retrospective study can help trainers to give a tactical appropriate response to situations of inferiority as well as superiority for the benefit of the team.

Key words: tactic, sportcode, substitutions, notational analysis.

Introduction

Handball is a sport determined by various aspects that involve both the player and his surroundings, either inside or outside the competition. Among them, three stand out: the individual performance of each player, the elements related to the tactical components and the interaction of the team (Wagner, Finkenzeller, Wuerth, & Von Duvillard, 2014). These three factors have been subjected to their own evolution over the years in which the sport has existed. As a result, the handball has evolved towards a more dynamic and fast game both in attack and defense. This development and evolution has been supported by a greater scientific knowledge about handball in different areas. Among them can be highlighted the new methods of training (Raeder, Fernandez-Fernandez, & Ferrauti, 2015), skills of the sportsmen (Aguilar-Martinez, Chiroso, Martin, Chiroso, & Cuadrado-Reyes, 2012), performance indicators (Drikos & Vagenas, 2011), conditional factors of the development of the game (Mortimer & Burt, 2014) decision making by trainers (Debanne, Angel, & Fontayne, 2013) and players (Elena, 2013), as well as contextual factors of the development of the game (Lago, Gomez, Viano, Gonzalez-Garcia, & Fernandez-Villarino, 2013).

Different studies have focused on the full profile of the players, from the anthropometric characteristics to cognitive skills (Wagner et al., 2014). In the same way that the sportsman and his characteristics have been studied, tactic situations, either offensive or defensive (Espina-Agullo, 2013) have also been of interest for researchers. The defensive role of the team, and specifically that of the goalkeeper, has even been the subject of recent study (Espina-Agullo, Perez-Turpin, Jimenez-Olmedo, Penichet-Tomas, & Pueo, 2016). The incorporation of all this knowledge helps to know in greater depth the conditions to which the male handball players (Michalsik, Madsen, & Aargaard, 2015) and female handball players (Michalsik, Aargaard, & Madsen, 2015) are subjected to. In this way, it is possible to maximize the performance of the players and develop training methods and game strategies that guarantee the success of the matches (Debanne, Fontayne, & Bourbousson, 2014; Belka, Hulka, Safar, Weissner & Mikova, 2016).

However, few studies have focused on the analysis of the periods where one of the two teams is in numerical inferiority of players (Oliveira, Gomez, & Sampaio, 2012). This particular game situation requires a restructuring both defensive and offensive of the game, since changes in both teams have to be produced to cover the loss of a player in the field. The loss of a player in the team could have influenced the game in a different way over the years due to the evolution of the game, as well as players and coaches mentioned above.

The objective of this study is to establish the relationship between the periods in which a team is in numerical inequality (either for or against) and the final result of the match in the finals of the European Championships, World Championships and Olympic Games between 1982 and 2012.

Material & methods

Participants

In order to develop this study, 32 men's handball finals from 1982 to 2012 were analyzed. The sample includes matches from the first 10 European Championship finals (1994 to 2012), 14 World Championship finals out of 23 played (1982 to 2013), and Olympic Games finals (from Los Angeles 1984 to London 2012) of the 11 matches played until now. The study was carried out with material from videotaping of broadcasts from general and sports television. The oldest recordings were made in VHS format with 250 lines of definition, the intermediate periods in PAL Standard Definition (720x576) and the latest in digital High Definition (1280x720). In any case, the resolution of the image allowed an appropriate observation.

Instruments and procedure

SportCode Pro v.8.5.2. software has been used for the analysis of matches. In total, 185 situations of inferiority have been analyzed. The analysis of the videotape recordings was performed by two experienced observers. To ensure the reliability of observation during the study, two visualizations inter-operator were carried out (Davies, 2008). For each variable analyzed, we calculated the percentage of error from the following mathematical expression (Hughes, 2004):

$$\text{Diff (\%)} = \left(\sum (\text{mod}[V_1 - V_2] / V_{\text{mean}}) \right) * 100\%$$

where V_1 and V_2 are the variables of observation, V_{mean} is the average value, mod is the abbreviation for modulus and \sum is the summation. The calculation of reliability on the inter-observers analysis obtained a margin of error of less than 5% (James, Taylor & Stanley, 2007), so the observation was valid.

The analysis of the matches focused on the partial result that both teams obtained when a situation of numerical inequality occurs, either by exclusion or by disqualification. A matrix of observation was established to analyze the situations of inequality as well as goals during that period of time. Finally, the results obtained were grouped in four large blocks of eight years each, referred to as the Grand Olympiad (GO) 1 (1982-1988), 2 (1989-1996), 3 (1997-2004) and 4 (2005-2012). This grouping allowed observing and comparing the evolution of the influence of these exclusions during these periods of time. Similarly, periods of inferiority on the basis of the time of the match in which they happened were categorized. In order to do that, the 60 minutes of the match were divided in 6 periods of 10 minutes each (T1 to T6) and a final period T7 was assigned to the extra time.

Once established the objective of the study and the analysis variables, the following methodological steps were followed:

- Recording and digitization of images.
- Creation of matrixes of code with the elements to be analyzed.
- Coding of images with each of the codes created.
- Combination of codes to obtain a quantification of the partial results of goals scored and/or conceded during the period of inferiority.

Statistical analysis

The data were analyzed with the statistics program SPSS v.22 making descriptive statistics. The statistic Kruskal-Wallis was applied to establish the significance in the analysis of inequality number related to the partial and full results of the match.

Results

From the total games analyzed ($n=32$), there were a total of 185 actions of numerical inequality due to exclusions and disqualifications penalized by referees during a period of 2 minutes. The average of the number of exclusions and disqualifications per game from each of the Grand Olympiads (GO) was increasing as time was passing; GO 1: 4.25 ± 2.50 , GO 2: 4.86 ± 2.54 , GO 3: 5.80 ± 3.77 and GO 4: 6.91 ± 1.70 . With regard to the time of the game when exclusions happen, it is observed a similar increasing trend, especially for the time frames belonging to the second period of game: T4 to T7 (see Table 1).

Table 1: Against/for exclusions during time frames per Grand Olympiad

Time frames	GO 1	GO 2	GO 3	GO 4
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
T1	0.25 ± 0.38	0 ± 0	0.30 ± 0.48	0.18 ± 0.30
T2	0.50 ± 0.50	0.14 ± 0.24	0.70 ± 0.70	0.73 ± 0.53
T3	1.25 ± 0.75	1.29 ± 0.90	0.70 ± 0.56	1.64 ± 0.71
T4	0.25 ± 0.38	0.86 ± 0.24	1.20 ± 0.88	1.09 ± 0.66
T5	1.25 ± 1.38	1.43 ± 1.10	1.40 ± 1.28	1.64 ± 0.69
T6	0.75 ± 0.38	1.14 ± 0.73	0.90 ± 0.80	1.45 ± 0.58
T7	0 ± 0	0 ± 0	0.60 ± 0.84	0.18 ± 0.33

GO: Grand Olympic period

Results indicate that the second parts of the matches are those where more numerical inequality situations occur (62%). By contrast, the incidence is lower in the first parts (36%) and only 2% of exclusions and disqualifications occur in the extra time.

Comparative analysis of game frames within the same match establishes significant differences mainly for Grand Olympiads 2 and 4, as shown in Table 2.

Table 2: Values of significance of the test Kruskal-Wallis for the comparison of exclusions for time frames

Time frames	GO 1 <i>p</i> -value	GO 2 <i>p</i> -value	GO 3 <i>p</i> -value	GO 4 <i>p</i> -value
T1 vs T2	0.495	0.317	0.195	0.030*
T1 vs T3	0.215	0.007*	0.269	0.010*
T1 vs T4	0.252	0.003*	0.163	0.020*
T1 vs T5	0.418	0.002*	0.215	>0.01*
T1 vs T6	0.445	0.003*	0.324	>0.01*
T1 vs T7	0.296	>0.01*	0.354	>0.01*

* Significant at $p < 0.05$, GO: Grand Olympic period

On the other hand, the results show how during the first three Grand Olympiads, those teams in inferiority ended winning the match. This trend is reversed for the last GO analyzed, as shown in Table 3.

Table 3: Percentage of victory and defeat by Grand Olympiad

Grand Olympiad	Win	Lose	<i>p</i> -value
GO 1	75.0%	25.0%	0.240
GO 2	57.1%	42.9%	0.386
GO 3	59.9%	40.1%	0.613
GO 4	27.3%	72.7%	0.173

Results indicate that no significant differences are established between the number of situations in which there is a numerical inequality and the relationship with the victory or defeat of the match ($p > 0.05$).

Discussion

The study of the game situations, as well as tactical systems have contributed to a greater knowledge and understanding of the factors of performance in the sport of handball. Numerical inequality situations allow knowing the real influence of these periods of time marked by the lack of one or more players on the field. In addition, they have a quantitative importance since they represent a significant percentage of the total game time. It is established that 30% of the game time is performed under numerical inequality situations, which means that a team face around 15 situations of attack in numerical inferiority by match. Therefore, in this paper they have been studied in retrospect to help give a suitable tactical response to situations of inferiority as well as superiority. This is based on the premise that the exclusions of players are given as a result of an action where the referee penalizes for 2 minutes (Srhoj, Rogulj, Padovan, & Katic, 2001). However, the number of exclusions per match throughout the different Grand Olympiads studied in this paper, establish an increase in this type of sanctions. In the last Grand Olympiad, exclusions increase in an average of 4.25 to 6.91 per match. This increase may be due to the successive modifications in the regulation whose objective has been to favor the attacking game, making a fairer game. Therefore, the referees apply more rigorously disciplinary sanctions, both by the requirements of the regulations and the characteristics of the current handball.

The present study indicates that the exclusions are not given homogenously throughout a match, but that last time frames of the match (T5 and T6) present a greater number. This increase by Grand Olympiads and time frames may be due to two reasons. On the one hand, the concept of progressive sanctions established by regulation that referees should penalize with verbal warnings or cards or start sanctions with exclusion. Therefore, during the first periods there are a smaller number of situations of inferiority in the game. On the other hand, during the second periods in which the end of the match is closer, the defensive actions are hardened. As a result, referees sanction more rigorously, which leads again to an increase of the exclusions.

On the other hand, regardless of the moment when situations of inferiority occur, it must be taken into account the effect that these situations, either for or against, have on the final result of the match. This study shows that those teams that had greater number of situations of inferiority during the three early Grand Olympiads studied, ended winning the match. This result suggests that there was a lack by teams that were in such superiority during these periods of time. During these first Grand Olympiads, an active defense could make up for the lack of any player. However, the current technical and performance improvements make defensive tasks extremely difficult with one player less, leading the team in superiority to overtake their rivals. However, this tendency is reversed during the Grand Olympiad 4, where those who are in greater number of numerical

situations win only 27.3% of the matches played. Therefore, it must be considered that the characteristics of the players (Wagner et al., 2014, Eugen, Zenovia, Ion & Nicoleta, 2011) as well as the anticipation in decision-making (Debanne & Laffaye, 2015; Loffing & Hagemann, 2014), their improvement at the throw (Aguilar-Martinez et al., 2012; Wagner, Pfusterschmied, Von Duvillard, & Müller, 2012), time management (Gomes, Volossovitch, & Ferreira, 2014), team motivational atmosphere (Abrahamsen & Pensgaard, 2012; Vurgun, Feroduk, Ozsaker & Uludag, 2016) and therefore the greater difficulty in establishing defensive patterns with one or more players less in the line of defense means an obvious disadvantage for the team in numerical inferiority when trying to concede the least possible number of goals.

Conclusions

This study has shown that the number of exclusions is increasing as time passes throughout the four Olympic Blocks studied. Also, it establishes that exclusions are produced from the half of the second time until the end of the match, which is a total of 62% of the whole penalties.

Finally, it is indicated a change of trend in the success of the match depending on the number of exclusions. In the first Olympic Blocks, the team with more exclusions won the match, whereas for the last Olympic Block the trend was reversed: the team with more exclusions ended winning the match only in 27.3% of occurrences.

This retrospective study can help trainers to give a suitable tactical response to both situations of inferiority as well as of superiority, in order to take advantage of this situation of the game for the benefit of the team.

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